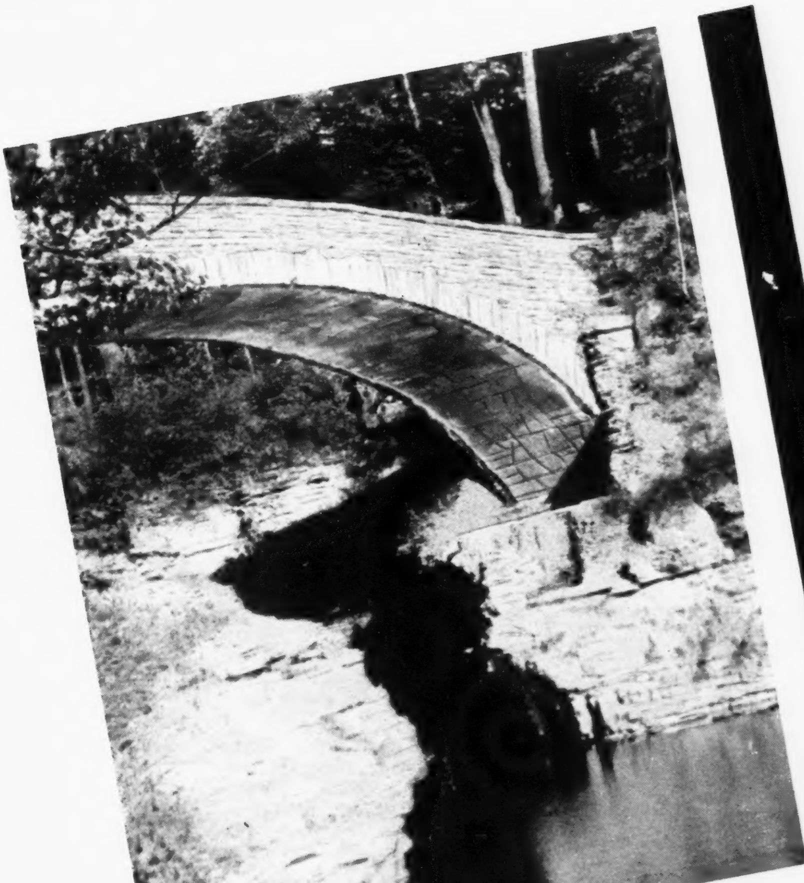
THE CORNELL ENGINEER



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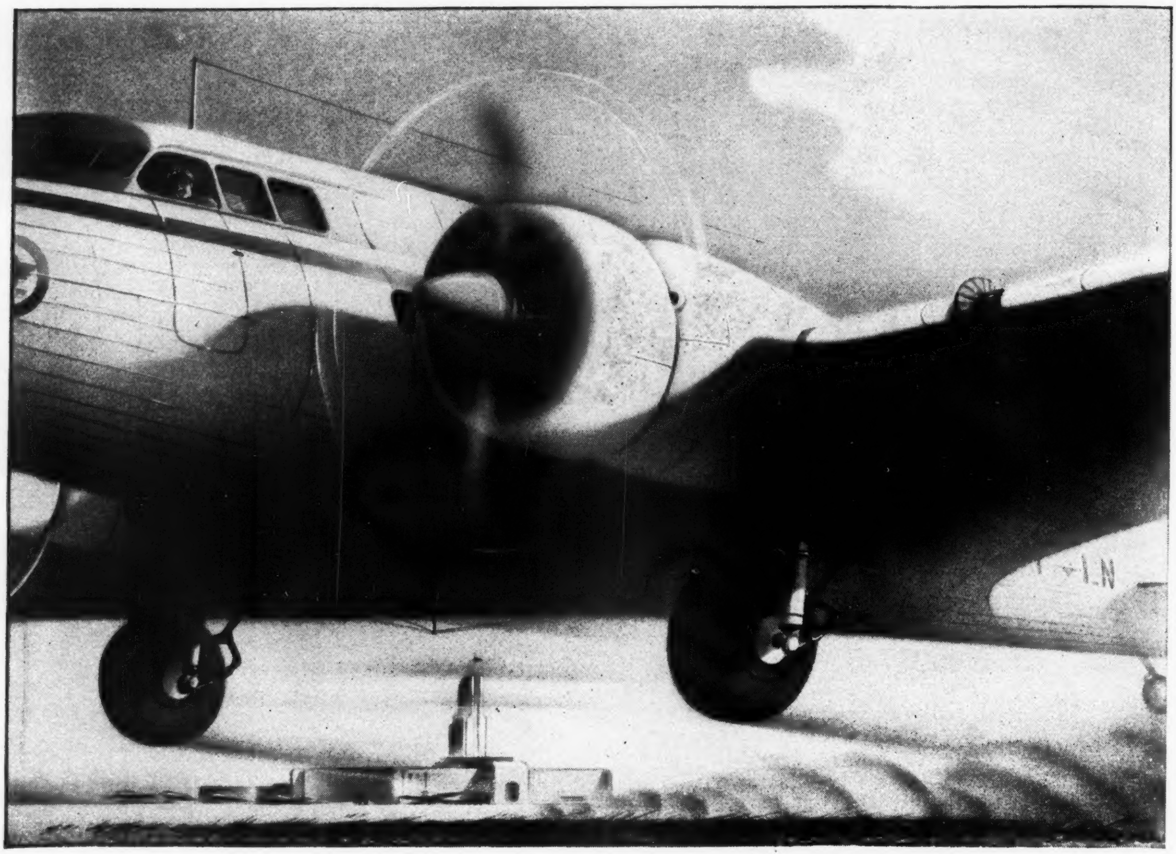

Editor's Column — M. R. Sfat

The contrast between Ithaca winter and Ithaca spring makes spring a most welcome transition. Its inspirational value has resulted in the contemplation of new enterprises and has released ambitions which winter has kept in the more remote recesses of an engineer's active mind.

Indeed, in the springtime a young man's fancy turns to thoughts of achieving success and even to poetry. Here, at Cornell, we are especially fortunate in having available many means of making the best of our ambitions. A survey of the Cornell University Official Publication, "Announcement of Prize Competitions," shows an abundance of contests, some of which are over, but many of which will still be open when this publication is being read. There are a number of speaking contests, practically all of which result in financial remuneration for the winners. Most noteworthy of these are the Fuertes Memorial Prize, the '94 Memorial Prize, and the Woodford Prize. Most engineers balk at entering these contests because of a feeling that engineers and public speaking do not mix. On the contrary, engineers are often required to depend upon their ability to sell an idea in front of a group of people and the only way that one can learn how to present an idea by oral means is to practice. We are fortunate enough to belong to a University which is well endowed with opportunities of this nature. Furthermore, employers look for those extracurricular activities when they survey a student's record. An individual who exhibits some effort beyond that which is required by the normal course of studies is bound to continue this habit, and employers are well aware of this.

There have been, and continue to be, engineers who have made marks for themselves in the fields of music and entertainment on the campus. The doctrine which some members of the engineering faculty (fortunately, a minority) adhere to, a doctrine which has caused some unfortunate faculty-student relationships, contends that a good engineer cannot be good at anything else—a "good" engineer must restrict his field of endeavor to a rigid technical education. That this doctrine is without foundation is best proved by the lives of such famous Cornell engineers as Tell Berna, John L. Collyer, and the well-known Dean Emeritus Dexter S. Kimball, a man who has never failed to fascinate his listeners by his diversity of knowledge. Of course, there is a limit to one's outside endeavors, but that limit is not a zero quantity, as some members of the faculty contend.

Owing to an oversight, we failed to acknowledge the cuts used to illustrate Mr. Tell Berna's article "In Defense of Defense". These cuts were furnished by the courtesy of the Cincinnati Milling Company.

The

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—*Courtesy* MECHANICAL ENGINEERING

Aviation looks ahead

Engineers In Aviation

A degree in aeronautical engineering is not prerequisite for a position in the aviation industry.

WILLIAM J. McCANN, M.E. '38

A member of the 150-lb. freshman crew and holder of a State Scholarship during his undergraduate years, William J. McCann upon graduation obtained a position with the New York State Gas and Electric Company. He remained in their employ for about sixteen months and then in October, 1939, left to work at the headquarters of the National Advisory Committee for Aeronautics in Washington, D. C.

The cuts used to illustrate this article are furnished by the courtesy of the *Aviation* magazine.

THE AVIATION industry holds considerable interest for the young man entering the engineering profession. However, he may have a somewhat hazy idea as to the part played by engineers in this newest of industries. Therefore, it is the purpose of this article to outline in a brief way the manner in which engineers fit into this picture.

It would be interesting to follow the course of an airplane from the original sketches drawn on the back of an envelope to the production of the 2000th plane of this particular type and see how the various engineers fit into its planning and construction.

Every successful type of airplane first starts out as a rather indefinite mechanism that is to serve some specialized need, either in civil or military aviation, and which therefore, must be able to fly a specified distance carrying a crew of so many men, and with some very definite objectives as to its load carrying ability, operating altitude and speed. To meet these requirements with available materials and engines necessitates the highest possible degree of coordination between the various design groups in the engineering staff, particularly if a high performance military airplane is to be built.

After the aircraft manufacturer has obtained the specifications that his airplane will be required to meet, a design conference is called and the aerodynamics group, power plants group, the structures group, and production group, all express their opinions as to the general type of airplane which will best meet the purchaser's specifications. At this conference some decision is reached on the types that will be studied and one or more will be selected for rather complete design studies, which may include extensive wind tunnel testing of a large number of scale models. Finally, after many additional design conferences, a type is selected and the detailed design program started. It is at this point that the aerodynamicists must reach a series of compromises with the structural design men, the power plant men, armament experts and production men.

The aerodynamicists usually start the ball rolling by sketching their ideas as to the optimum form of the airplane, indicating the location of the wing, engines, cabin, control surfaces and the probable weight distribution. The structural designers may then point out that the wing spar passes directly through the pilot's compartment with the result that the pilot must be moved forward or the wing raised or lowered sufficiently to eliminate this difficulty. Or the land gear required for the original design may be too long to be satisfactorily retracted into the wing or engine nacelle. These and other structural limitations may cause general revision of the airplane several times while it is still in the preliminary design stage.

Finally, the form of the airplane is fixed to some extent and scale models are constructed. If the plane is of fairly conventional design, the model tests may be restricted to studies of the stall characteristics, spin behavior and stability. However, if the design is radical, the tests will be extensive. They will include studies of the stalling, spinning, and stability characteristics of the model and may also include cooling investigations, pressure surveys over many parts of the wing and fuselage, studies of various arrangements of the tail surfaces, measurements of control force effectiveness, and studies of many other aerodynamic problems. With the exception of a portion of the cooling tests, nearly all of the model testing is directed by the areonautical engineers.

This method of designing an airplane would appear to be somewhat empirical but the large amount of research which has been done in various laboratories has almost completely eliminated the cut-and-try method from aircraft design. Occasionally, however, when a new type of airplane is being developed, considerable effort must be expanded on certain problems—for example, the design of tail surfaces and control surfaces so as to provide adequate stability and control. In some instances, these problems cannot be completely solved in the wind tunnel and must be done in actual flight. It is likely that new methods of wind tunnel testing will eliminate even this difficulty.

STRUCTURAL DESIGN

At this stage in the design, the airplane is turned over to the structures group for detail design of the load carrying members. In recent years, the monocoque or stressed-skin type of construction has proved to be most satisfactory and economical. This is not entirely

suitable for use in military planes, since large portions of the wing and fuselage must be removable so as to permit serving the armament and dropping bombs from the fuselage. Therefore, most high performance airplanes at the present time use a combination of monocoque and internally braced structures that are extremely complex and provide the stress analyst with many difficult problems. Research is being made continually on elements of structures and complete structures as used in aircraft, so that a good structural man is always learning new methods for solving problems which were previously beyond any possibility of more than an approximate solution.

Closely allied with the work of the structures department is that of the materials group, which develops and evaluates new materials and methods of fabrication. An efficient aircraft structure is one which supports the loads to which it is subjected without excessive distortion and is an economical structure from the point of view of weight and cost of production. For tnis reason manufacturing processes, such as spot welding and riveting, play an important part in the work of the materials group. They must determine the allowable loads which may be placed on all types of structures and joints, as well as study the manufacturing methods which are used with these materials. An increasing part of their work is in the field of plastics or plastic-bonded woods. These plastic materials offer particular promise because of their high internal damping qualities, which are extremely useful in the construction of aircraft parts subject to flutter or vibration. Many of the foremost men in the structural field at the present time have had a background of civil engineering with considerable experience in structural design. Others are metallurgists or chemists and do a large share of the work in materials research. Naturally there are mechanical engineers and electrical engineers involved in the study of production methods and shop practices. It is interesting to note that in this one group, namely structures, we find all types of engineers involved in aeronautical work.

Electrical engineers must decide upon the wiring and design of these complex engines. Structural engineers are needed in structural design.

The power plants group also takes a considerable part in the design of our airplane. They must provide an installation which is free from objectionable vibration, supplies adequate power, is properly cooled, can be serviced in the field, and above all, does not add seriously to the aerodynamic drag. The matter of designing a proper propeller and engine cowling lies between the power plants group and the aerodynamicists, since both groups are directly affected by these problems. A large part of the vibration study which is made on an airplane concerns the mounting of the engine and propeller unit. This work consists of the development and installation of electrical pickups which are sensitive to vibration or variation in strain within the material to which they are attached and also to the development of electrical circuits which amplify and record these observations so as to permit careful analysis of the vibration problems.

The Full-Scale Mock-Up

Aircraft have become so complex in the past few years that it is almost impossible to provide a large enough number of two-dimensional drawings to describe completely the structure, engine, armor, armanent, and accessories. For this reason all makers of aircraft, either military or civil, construct an airplane that is merely a three-dimensional full-scale drawing of the proposed plan. This is worked out by the structures, aerodynamics, and power plants groups. The customer examines the mock-up and may suggest changes in the seating arrangement, or location of the guns, or the position of certain auxiliaries which would make the airplane more useful for his particular purpose. One example of the type of studies that may be made on a mock-up of an airplane concerns the development of the recent sleeper plane by a prominent manufacturer. The engineer designing the cabin interior had little or no previous experience to use in his design of the sleeping accommodations, since this was the first real attempt to provide customer comfort in an air sleeper. Therefore, he and some of his staff slept night

Civil engineers are needed in structural design.

after night in the mock-up of the transport plane, trying out variations in bunk location and design as well as several types of ventilation. This finally resulted in a very satisfactory solution to his problem.

The difficulty that is always present in attempting to lay out accessible pipe lines and control cable passages on a drawing board is absent when such problems are solved in full-scale mock-ups. These and many other problems make the mock-up airplane, with its galvanized iron and plywood construction, a very great help to every aircraft design staff. In some cases the mock-up is made of such material that it can be placed in a full-scale wind tunnel for aerodynamic tests.

The Prototype Airplane

The next step in this process is the construction of two airplanes, one for flight tests and another "static" airplane which will be used for extensive structural tests. The flying experimental airplane is used in making cooling tests to determine whether or not the engine is cooling properly under all conditions of flight and also to determine whether or not this cooling is obtained at the expense of performance. At the same time, tests are made on the stability of the airplane, maneuverability, recovery from spins, take-off requirements, landing requirements, and many other qualities. Usually these flight tests will show up any fault which may reduce the usefulness of the airplane.

Engines and other major parts which are not designed to carry part of the load are not installed in the "static" airplane. Tests are made on this plane to determine how its structure will respond to the various types of air loads, ground loads encountered during the landing, take-off, and taxing periods, or acceleration loads due to maneuvering in flight. The various members are loaded by means of bags of shot or hydraulic cylinders so as to simulate, so far as possible, the lift and drag effects of air flow which occur while the plane is in flight. Concentrations in weight such as are present at the engine mounts, fuel tanks, armament and armor installations are also simulated by weights or hydraulic loading mechanisms, so that the load condition of the entire structure simulates some critical flight conditions. These structural tests must be very well planned in advance so as to cause the loading to follow as closely as possible the true aerodynamic load distribution and also to assure that the critical loading conditions is tested. The usual practice is to assume several conditions in flight as critical to the various parts of the structure, since no one maneuver will simultantously provide maximum load for all the structural elements. Considerable ingenuity is often required in obtaining the proper load distributions, and a large amount of development work in this type of testing is required at the present time. This work is largely supervised by the structures group and the areodynamicists who assist in the computation of the air loads.

Production Planning

Some revisions are usually found necessary in the flight and structural testing programs, but sooner or later the flight airplane is revised and takes the form of the final airplane. At this time the manufacturer makes every effort to "freeze" the design or prevent further changes. The design is then turned over to the production men and plant layout group for its final production planning. The industrial engineer has a large part in this work from now on, and he may suggest certain major changes in the airplane structure which greatly facilitate production. He also has the problem of providing new types of tooling whever it is required, and must assure himself that adequate supplies of material are available. The number of units to be produced will play a large part in the selection of production methods and tools, and in some cases it has been found practical to construct

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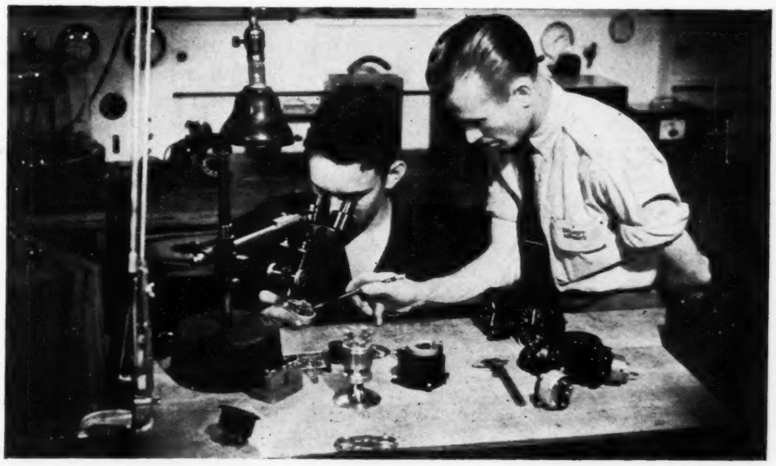
Research men trained in metallurgy find new and better alloys for airplane construction.



Yellow River Regulation

Translated from the Chinese by

CHEN-HSU T'ANG, Ph.D.

IN THREE PARTS

PART III—Flood Waters, River Bends, Silt

WE SHALL now discuss a second point that will be of great value in further investigation.

2. *The flood-water discharge capacity must be controlled.* If excessive flood water is not controlled, the lower reach of the river is still in danger of flood disasters. The Commission is considering erecting detention reservoirs along the tributary valleys in the upper and middle reaches of the Yellow River. These reservoirs would be used to store the excess flood-water discharges. For example, the capacity of the river channel at the lower reach of the river has been computed and the channel has been designed to accommodate a discharge capacity of 6,500 cu. m. per sec. The flood discharge for the flood of 1933 was 23,000 cu. m. per sec. The excessive amount of 16,500 cu. m. per sec. should have been stored in reservoirs. This excess quantity can be stored and disposed of at several places. The Wei Ho will be able to take care of at least 30% of the excess discharge; the North Lo-Ho will be able to store at least 15%, and the Fen-Ho will be able to store at least 10%. The other two tributaries, the Lo-Ho and the Chin-Ho, may also be able to take care of additional amounts. During flood periods the excess discharges may be handled by proper use of telephone, telegraph, or radio communication and an adequate scheme of reservoir control. The total discharge moving downstream from the reservoirs should not exceed 6,500 cu. m. per sec. In such a manner, the danger of abnormal flood disasters will be obviated in the future.

The detention reservoirs at the different tributaries should be emptied before the flood season. During flood periods, a certain quantity of water must be discharged through the bottom outlet works (1) to prevent silting up of the reservoir; (2) to provide a sufficiently strong current in the lower reach of the river; (3) to prevent river disasters. The quantity of water to be discharged from a reservoir should be determined accurately by computation according to the tractive force of the water and silt conditions. This computation should be supplemented by model studies. Until completion of the reservoirs the flood water will be stored on the overbank areas, which will constantly be silting up. It is hoped that the overbank and foreshore areas will have been adequately built up by the time the reservoir system is completed. Otherwise excessive flood water will still be able to damage the overbank area and our purpose will still remain unfilled.

Dr. T'ang made two translations from the Chinese of technical interest during his visit at the U. S. Waterways Experiment Station, Vicksburg, Miss., in the months of May and June of 1940. The two translations were: *A Study of Yellow River Regulation* and *Emergency Measures for Yellow River Main-dike Protection.* Dr. T'ang made the translations as a token of appreciation for accommodations provided him by the Experiment Station in connection with his study on river and harbour models.

The complete manuscripts of both translations are deposited in and can be borrowed from the following three places: Office of the Chief of Engineers, U. S. Army, Washington, D. C.; Engineer Department Research Centers, U. S. Waterways Experiment Station, Vicksburg, Miss.; or Cornell University Library, Ithaca, N. Y.

That it is very easy for a reservoir to silt up and lose its usefulness is a universal worry. The Commission is not concerned about silting within the reservoir, but believes it is really necessary to consider the silt problem below the reservoir. Within the narrow gorges the flow will be steep and swift and it will be possible to flush the silt away completely; however, if a 24-hour discharge is distributed over a period of 10 to 20 days the flow will be weaker, and the silt transported by these small controlled flows will be deposited on the river bed below the reservoir. Consequently, it is absolutely necessary that the regulation of the lower reaches of the river and the reservoir system of the upper river reaches be carried out at the same time on the basis of accurate computations.

3. *Bends must be eliminated.* The slope of the river bed below Mengtsin is considered more or less "uniform," but there are too many sharp bends and small branches. The sharp bends can be eliminated by cutoffs, and the small branches, after being diked off with permeable willow dikes, will be silted up during flood periods. After all the branches are diked and the river has been confined to one channel it will not be necessary to worry about too shallow depths at low stages. After the elimination of sharp bends and shoals the water will flow suitably and there will be no obstruction to cause ice jams.

4. *The silt problem must be investigated.* Below Mengtsin the only two items causing trouble are clay and sand. In solving this problem, we must first investigate

Yumenkou at foot of gorges below Hu-Kuo.

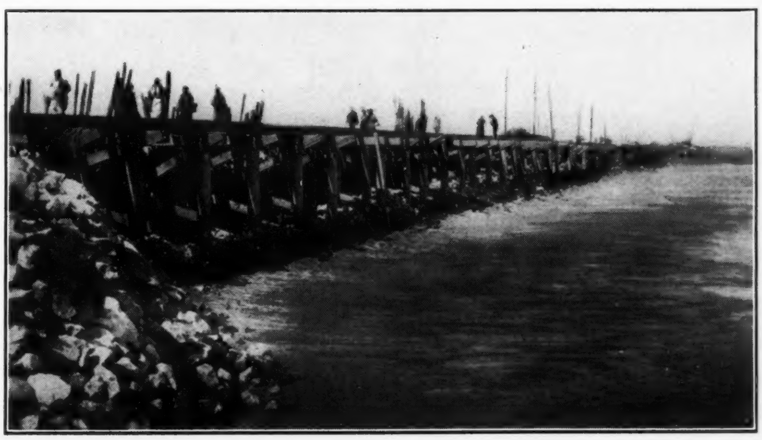
the origin or source of these materials. The clay is composed of very fine particles and travels in suspension with the flow. It comes from a far-distant origin and will be able to travel a long distance farther. The sand particles are coarse and settle to the bottom where they are deposited and transported by the water by being rolled along the river bed. The sand can not possibly come from a very distant origin and will not be able to travel any considerable distance. There is more sand in the Honan District and less sand in the Shantung District due to the comparatively difficult transportation of sand particles. The clay will be able to travel all the way to the sea. Because of the fact that Honan sand barely reaches Shantung it would be unreasonable to insist that the sand in the lower reaches of the river comes from the Ho-Tao region. Along the two banks of the Yellow River above Mengtsin there are numerous hills and tributaries. Why must sand necessarily come from the Ho-Tao region? Ho-Tao sand is fine, but Hu-Kou sand is coarse. From upstream to downstream the deposited sand grains should grade from coarse to fine; there is no reason for the sand particles to grade from fine to coarse. Therefore unless the particles of Ho-Tao sand change in size it is difficult for them to be transported even past Hochu. How can they possibly reach Honan? Moreover, through Suiyuan Province the general topography is flat and the river is wide; the heavier sand particles are naturally deposited in this region. The sand will not be transported farther unless it is reduced in grain size.

Let us consider the tributaries along the banks of the Yellow River. In the case of tributaries with origin far distant from the river the sand brought down to the river will be of fine particles. In the case of tributaries with origin very near the river, the sand particles transported to the river will be coarse. Consequently the sand carried down by the Fen-Ho, Lo-Ho, Ching-Ho, and Wei-Ho is comparatively fine and the water entering the river from the Shansi and Shensi banks above Lungmen will contain comparatively coarse sand, (water from the Shensi side occasionally contains small stones). The sand brought down by the tributaries north of the Wei Ho consists of fine particles and that brought down by the tributaries in the southern mountains is very coarse. Once the sand, coming from above Lungmen, passes this point, it is deposited because of the widened channel. At Shanchow below Tungkuan the river bed is composed of coarse sandstone. Therefore, we know that the sand does not come from the upper reach of the river. The major portion of the fine sand of Honan will come from the gullies along the two banks of the river from Tungkuan to Kunghsien and only a very small portion will come from the upper reach of the river. The above statement is based on deductive reasoning. It is still necessary to await proof by subsequent data. The Commission is conducting field investigations at the present time and also has a well planned program as a basis for a systematic investigation of the silt problem.

The origin of the clay is naturally at a considerable distance. Since the clay travels with the same velocity as the river flow, and since there is no deposited clay along the river bed nor the beds of its tributaries it is evident that all the clay has a tendency to travel down to the lower reach of the river.

After we understand the origin of silt we can proceed with investigation of methods for its decrease or elimination. The elimination of the clay and the elimination of

Completing rock-fill dam from trestle across the Yellow River to divert flow back to its old bed.



sand can be handled by different methods. The sand originates in the gullies, where small check dams will be installed to retard the flow and decrease the amount of clay travelling down to the river. The clay is chiefly a type of loess (in Chinese "huang tu" or yellow earth) and comes from the top-soil cover. It will be possible to eliminate the clay by proper cultivation of the soil and by ditching.

The use of a system of ditches is usually not agreeable to the farmer (1) because ditches reduce the area of tillable soil, and (2) because it is necessary to repair and deepen them annually. For this reason it is necessary to devise a new method for cultivating the land (see figure 1). The farm is divided into furrows, tillable areas, and enclosing embankments (topped by a footpath and used to divide the fields). The embankments should be high, the width of furrows about five feet. and the width of tillable areas from 20 to 30 feet. The surface of the latter is a convex arc and is easy to cultivate. In the furrows, trees or some type of peas, beans, or grains may be planted. It is not necessary to plant trees in every furrow; this will be governed by local conditions. Snow and rain water will collect in the furrows and the top soil of the farm will not be eroded. This procedure will benefit the farmer as well as the river. This scheme is to be applied in the Northwest Territory. If the government enforces the matter it can be effectively carried out.

The effect of elimination of silt by reforestation will be very small and very slow. Although it is necessary to encourage the planting of trees in the Northwest Territory, still we are not allowed to build up a psychology which depends upon reforestation as a measure of river regulation.

As previously stated the chief aims are as follows: to reduce river disasters in the lower reach of the river, to regulate the river channel properly, and to restore river transportation facilities. Although the river reach from Tungkuan to Hancheng is not a flood-protection reach, flood disasters occasionally occur there. Regulation by stabilizing the river bed and causing the channel to scour should be carried on in the same way as in the lower reach. In this portion, the purpose is to provide adequate navigation accommodations for small steamboats. It seems unnecessary to concentrate on building dike protections. On the reach from Ninghsia to Paotou the scheme for stabilizing the river bed should be used at those places where the channel is widened; at those places which are narrowed the water depth will naturally be adequate and it will only be necessary to remove projecting rocks and shoals in order to provide for steamboat navigation. The reaches from Paotou to Yumen and from Tungkuan to Mengtsin are intended only for junks. The chief engineering problem in these two sections is to improve navigation conditions at the Hu Kou (Pot Mouth) and San Men (Three Doors)—two dangerous passes (see figure 2). At Hu Kou Pass it is suggested that an "incline" be installed; a steel rail will be attached to the incline and boats will be lowered by machinery. At San Men Pass an endless chain will be installed between Chao - Wo - Lai Rock ("Come Toward Me" Rock) and Jen-Men

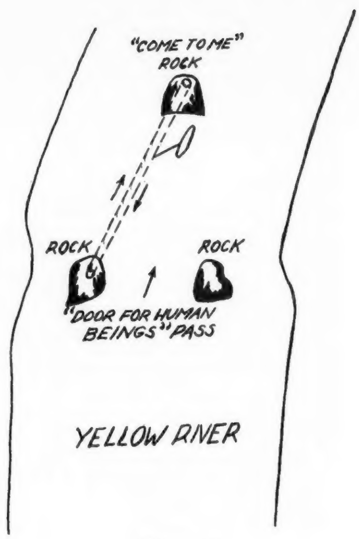


Figure 2

Rock ("Door for Human Beings" Rock). The endless chain will be operated by machinery so as to tow the boats up or downstream. Below Tungkuan, in the vicinity of Shouhsiang there is a reach in which the current is very swift. This reach should be regulated. At some points on the widened sections the use of T-works is recommended to regulate the river bed so that the river will not spread out and cause shallows which would be a menace to navigation.

The promotion of the irrigation enterprises in the Northwest Territory is most certainly beneficial to the people. However, we must not get the mistaken idea that just because the irrigation system is developed, flood disasters will be reduced or eliminated at the lower reach of the river. The irrigation canals do not allow flood water to enter as this would incur the danger of silting. It is not possible to say that because water utilities are developed at the upper reach of the river there will be no flood disasters at the lower reach of the river.

The use of lower reach river water for the fertilization of low, sandy lands by flooding is also one of the biggest water utilities. But if it is desired to reduce the flood discharge of the river by depending entirely upon this method, just how much reduction can be obtained? Only a very negligible amount. The fear that dividing of the water, by use of water to flood

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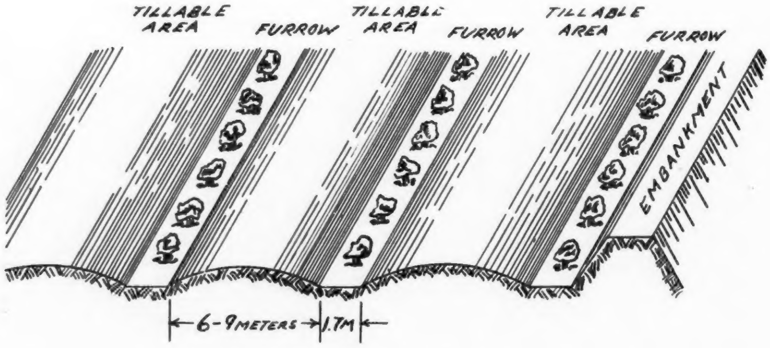


Figure 1

The Baking of Foundry Cores

CHARLES H. BARNETT, AE '43

IN THE general scense, a foundry core is a body of sand placed in a mold to form a corresponding cavity in the casting. From the familiar application of the core to form the shaft hole of a simple wheel casting, the use of cores ranges in increasing complexity up to foundry molds which are an assembly of cores. The cylinders of air-cooled aviation engines are often cast in the latter manner. It may be said, then, that the function of a core is to form certain faces in the casting, either interior or exterior.

The very simple prismoidal and cylindrical cores, known as stock cores, are made with plunger or screw-feed machines somewhat analogous to a pastry tube. Larger and more complex cores are either made by hand or produced in quantity with core-making machines similar in appearance and operation to molding machines.

Requirements of Cores

In order to produce good castings, the sand of both mold and cores should be properly vented so that the steam and gases produced by the molten metal can freely escape and not cause blow holes in the cast work. In addition to allowing free egress of steam and gas, a core must resist the pressure of the molten metal upon it and the cutting tendency of this molten material as well. In a limited number of cases cores made of ordinary molding sand will have these characteristics, but usually it is necessary to make cores from sand of a more open character than that used for molding. A sand of clean, round, uniform-sized grains which will pack tightly and yet provide enough space between the grains for the gas and steam to escape is most desirable; but such a sand could not be held together without the use of a binding material which is strong enough and at the same time is required in such small amounts that the venting of the cores will not be affected. Core mixtures, therefore, usually consist of core sand, molding sand, and old cores which have been crushed up. To these mixtures is added the core-binder.

There are two general types of cores. Green sand cores, having relatively poor mechanical properties, are used only to a very limited extent. Dry sand cores—all those cores which are made up of the above type of mixture and then baked to fully develop the strength and venting properties—are those most commonly used. The types of binders used in making dry sand cores may be classified as follows:

(1) Water-soluble binders — flour, molasses, dextrin, etc.

(2) Paste binders

(3) Colloidal and allied bodies —clay and glue-like substances

(4) Gums and pitches

(5) Oils—linseed, soy bean, and China wood oils.

These binders are ordinarily classed by the foundryman as either dry or liquid. Core room practice, including the mixing and grading of sands, selection of the proper binder, and making of cores, is too vast a subject to be adequately dealt with in the limited pages of this article.

Effect of the Binder

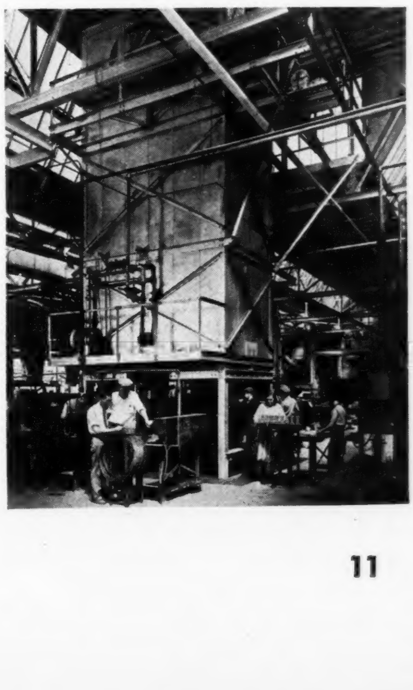
The purpose of the core-binder is three-fold. In addition to the strengthening and venting effects previously mentioned, the binder must be destroyable by continued contact with molten metal, for the core must crumble and be easily removed from the recess it has formed in the casting. When the core is baked, the binder will form thin, strong links between the sand grains and thus cement them together.

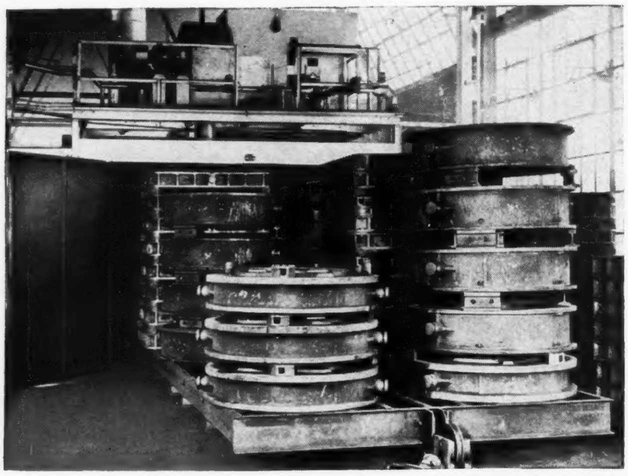
The Baking Process

Since cores with an oil binder, known as oil-sand cores, are most extensively used, the discussion of baking effects given here will apply primarily to that group, although the same underlying fundamentals hold true for other types of binders.

The baking time of a linseed oil-sand core may be roughly divided into three periods. During the first, or "heating up" period, the cores are brought to that temperature at which moisture and other volatilized products are driven off. The second period, during which these products are removed, is called the "evaporation" period. Linseed oil binders owe their hardness to the method of drying, which is one of oxidation when heated in contact with air; the period during which the cores are hardened and strengthened is therefore called the "oxidation" period. Baking temperatures for all cores range from

Tower type core oven in automotive foundry. Core-makers' benches are placed around base of the oven.





Car-type oven for drying molds. The work shown requires eight hours drying time at 400°F.

300° to 500° Fahr., depending on the binder used; in the specific case of linseed oil binders, the oxidation is best at temperatures from 350° to 450° Fahr. Above 500° Fahr. the oil film is destroyed, making a soft and weak core the result of overheating during the oxidation period. Upon the thinnest structure present depends the maximum safe temperature range. The common fuels used in core baking are coke, coal, oil, gas, and electricity. Since good heat control is required in all baking operations, some of these fuels find more extensive use than others. Coke, while inexpensive, is generally hand fired and is difficult to use in auto-control systems. By virtue of firing from an automatic stoker, the human element is reduced when using coal; the maintenance expenses of coal systems and the fact that soot is deposited on the cores restrict the use of this fuel. Where natural gas is available at low cost it is the ideal fuel for core baking. Gas systems give a clean heat, easily regulated, and lend themselves to the application of safety devices. Oil is also an easily controlled fuel and can be burned with a minimum of labor. The advantage of higher heat content and lower cost held by the heavier grade fuel oils is offset by difficulty in burning them cleanly and efficiently; hence lighter grades are preferred. Where off-peak load rates will effect a cost saving, heat may be generated electrically, but its use is otherwise very limited because of the high cost of electricity relative to that of other fuels. It must be remembered that a core is made to be used once and then destroyed; that fuel which will effect the proper baking most economically and efficiently is the one to use.

Heating Methods

In general, two systems of heating are in common use. In direct firing systems, the combustion gases travel over the work according to the draft, natural or mechanical exhaust being used. With this system, baking cannot be speeded up without loss of oven efficiency, because of high stack losses and non-uniformity of cores due to heat stratification within the oven. In recirculating systems, on the other hand, fans and blowers are used to circulate air and gases over and over again for uniform distribution of heat. Since, because of the recirculation principle, temperature within the oven may be flexible without harm to the work, this type of system is the more extensively used today.

Oven Types

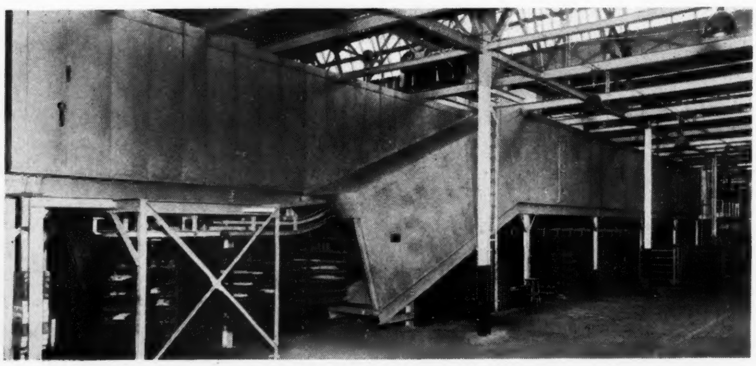
All core ovens may be classified as either brick or panel ovens. The early ovens had thick masonry walls and arched fire-brick ceilings supported by steel beams. The panel oven, a later development used in almost all modern installations, is constructed of sheet-steel panels with insulating material between, there being no metal connection between the steel panels constituting the inside and outside walls of the oven. Far less heat loss by absorption and by conduction is claimed for the panel type of oven.

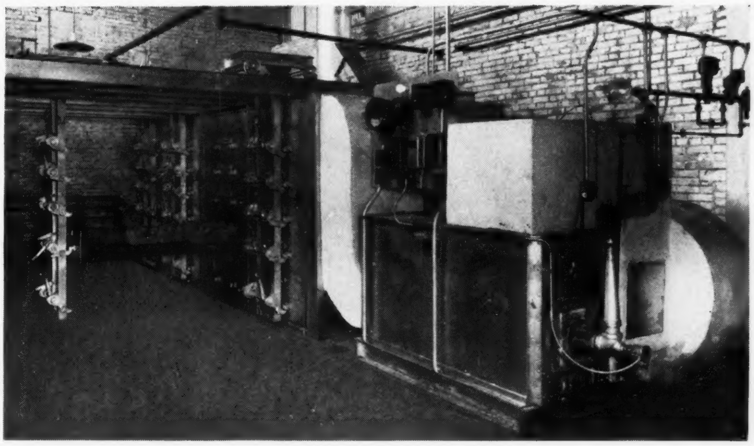
Ovens may also be classified according to the method of handling the cores, the type used depending on the individual requirements of the foundry itself.

Under this method of classification, the smallest and simplest type is the shelf oven. This is a small, shallow oven having, as the name implies, a number of shelves arranged in tiers. Its use is restricted to limited quantities of small cores which are placed in the oven, baked, and then removed. When the oven doors are opened to insert or remove cores, the whole interior of the oven is exposed, allowing the escape of heat and gases and making for poor economy and baking conditions.

For giving individual attention to a number of varying sizes and shapes of cores, the drawer-type oven finds extensive use. Arranged in tiers, the drawers are equipped with end plates or other devices to prevent the escape of heat and

Horizontal-type core oven with single-strand conveyor carrying racks spaced about six feet apart.





Group of four drawer-type core ovens, heated by means of a gas-fired recirculating system.

gases as in shelf ovens. By means of a master carriage rolling on an overhead track and a drawer-pulling mechanism for the selection of any one or combination of drawers, very delicate cores may be handled with a high degree of safety. Drawer sizes run from 2 ft. by 3 ft. up to 5 ft. by 10 ft., the most commonly used being a drawer 3 ft. in width and 5 ft. in length. In this type of oven are baked all manner of small and medium sized cores, such as those for valves, pipe fittings, brass goods castings, etc.

Under conditions where a large number of cores in varying shapes and sizes are produced, the core-makers' benches will usually be found spread over a large area. Transportation of cores to the ovens then becomes an important matter, and the portable rack type oven offers a convenient method of handling cores. The ovens of this type resemble large boxes divided into compartments, each compartment being designed to hold one or two racks, although four racks per compartment is sometimes used for small racks. The racks themselves are welded steel frames ranking from 3 ft. by 5 ft. by 5 ft. to 5 ft. by 7 ft. by 7 ft.; each rack has a number of shelves arranged in tiers. Lift trucks are used to transport the racks to any location in the core-room, where they are loaded and then placed in the oven. After baking, the racks are taken either to the molding floor or to storage. Each oven must be equipped with three complete sets of racks for efficient operation; while one rack is loading, a second is baking and a third is cooling or unloading. Aisle space wide enough to accommodate the largest used rack must be provided, and floors must be smooth so that cores can be moved without jarring or vibration. Rough handling may cause cores to sag or otherwise become deformed, in which event the casting would likewise be deformed and perhaps useless. The compartment doors on rack ovens are either horizontal swinging or lift type, the latter being much preferred where there is available head room, because of the space and heat saving economies which it offers. Recirculating heating systems are generally used with this kind of oven; up to eight single-rack or four double-rack ovens may be served by one heating plant. The flexibility of the ovens can be increased by decreasing the number of ovens served by a single plant.

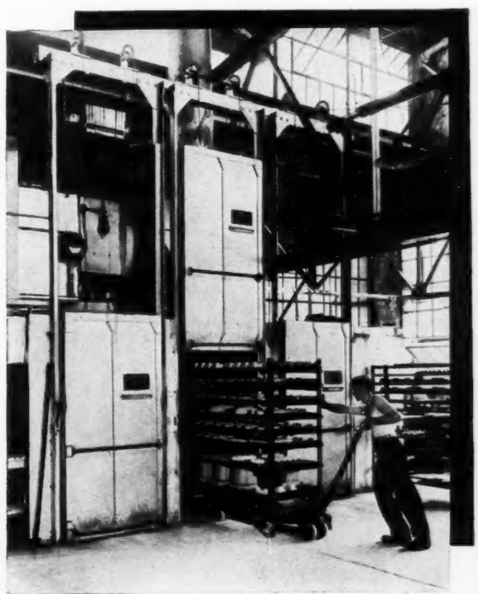
In large foundries where cores are constantly being used, production often justifies the installation of one or more continuous core ovens. These are essentially of three types: the vertical or tower type, the horizontal with double-strand conveyor chain, and the horizontal with single-strand conveyor or mono-rail conveyor.

Vertical ovens are from twenty-five to fifty feet and sometimes more in height. In addition to the advantages to be gained from economy of floor space and large capacity, this type of oven affords rapid operation and rapid turnover of core plates and driers, as well as good functional grouping of the core-makers' benches. Upon an endless chain system, which is guided and driven by sprockets at the top and bottom of the oven, are hung welded steel racks used for carrying the cores through the oven. Core-makers can be grouped around the oven to facilitate placing the cores on passing racks in pace with production from the core-making machines.

The double-strand horizontal conveyor is usually arranged to carry its racks past rows of core-makers' benches and then through

(*Continued on page* 24)

Portable rack-type ovens, all heated by an oil fired recirculating system, located on platform above ovens. Note the lift-type doors.



NEWS of THE COLLEGE

Diesel Engines

Sunshine and warm weather work wonderful changes in the "goings on" at the north end of our quadrangle. When the architects aren't lounging in front of their White Hall retreat in beach chairs, they are up to some other spring fever activity. On the day after Easter all left over eggs were assembled for a glorious egg rolling contest between the architects and engineers. Knowing how fast the engineers are when it comes to rolling eggs, our friends the architects ran the race by themselves. The victor, Bob Mueller, Arch. '41, was presented with a plaster of paris nude by Eleanor Roosevelt.

Comes spring, comes crew time, and we find the engineers doing more than their share of pulling. About one-third of the varsity squad are engineers.

We hear the co-eds are finding out that engineers don't have to be quite as busy now as they pretended to be last winter.

This spring, mingling with the Cornell engineers in their sport jackets and saddle shoes, are 47 Navy ensigns clad in navy blue uniforms and white hats. Their striking appearance as they walk in two's and three's, each with a slide rule and clip board under his arm, not only adds to the color of spring on our campus, but makes us aware of the major role our college is playing in the defense program. These ensigns have been detailed by the U. S. Naval Reserve to Cornell University for a sixteen-week course in Diesel engines given in the College of Engineering on a program designed to fit them for the operation and maintenance of engines on patrol vessels with the fleet. The group is spending full time on the course, which is part of the Engineering Defense Training program under the U. S. Office of Education. They have already had a training cruise on shipboard and have completed a course at Northwestern University. After the course at Cornell, they will be called immediately into active service.

Eleven members of the present faculty of the College of Engineering, under the direction of Professor A. C. Davis, are taking part in the lecture and laboratory instruction, and three new members have been added to the staff, according to Dr. Arthur S. Adams, director of the Engineering Defense Training Program. The group includes Professors V. R. Gage, C. O. Mackey, R. E. Clark, W. H. Hook, J. O. Jeffrey, and C. W. Terry, and Messrs. H. N. Fairchild, L. D. Conta, L. L. Otto, E. B. Watson, and L. T. Wright, Jr.

Three engineers with special qualifications have been loaned by industrial concerns to the College of Engineering for the duration of the course in Diesel Engines to be given to the 47 ensigns. The new faculty members are Harte Cooke, lecturer in experimental engineering, from the American Locomotive Company of Auburn, N. Y.; Ralph J. King, instructor in experimental engineering, from the Caterpillar Tractor Company; and John M. McLellan, instructor in experimental engineering, from the Procter and Gamble Company.

Mr. Cooke was for many years chief engineer of the McIntosh-Seymour Company and in recent years has been with the Diesel Engine Division of the American Locomotive Company. He is a noted designing engineer and is recognized as a pioneer in the development and manufacture of Diesel engines for land, air, and marine use.

"Mrs. Roosevelt." Where are "Sistie" and "Buzzie"?

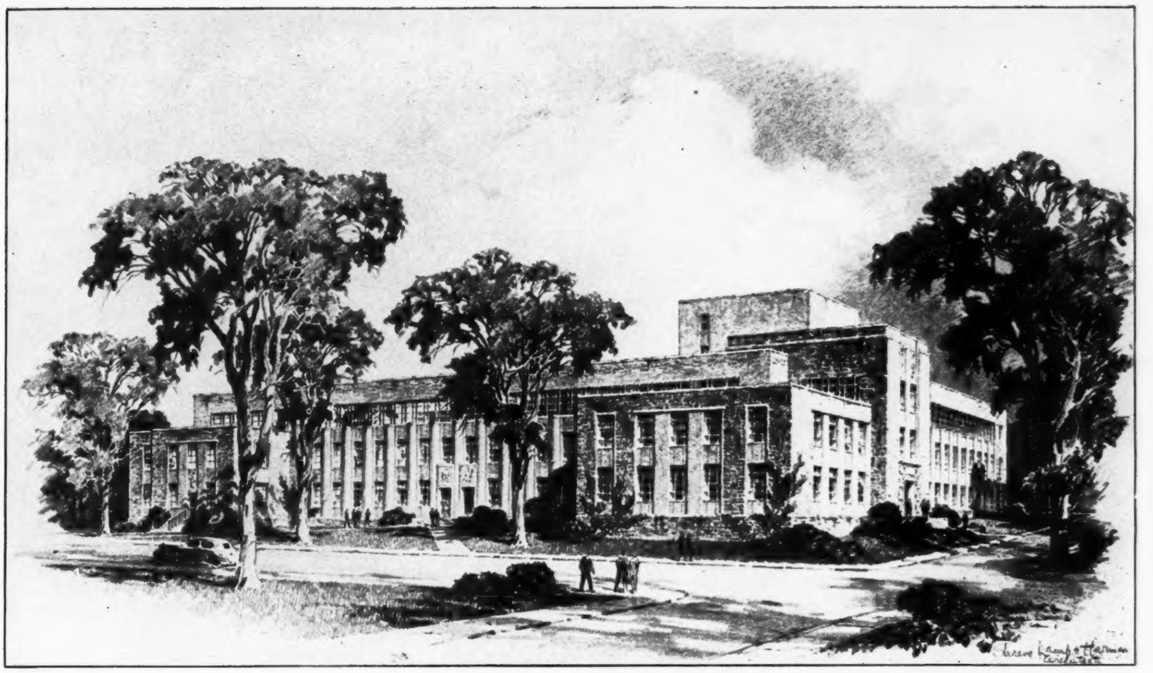
Mr. King attended Mesa Junior College and then the University of Illinois, taking his B.S. in M.E. degree in 1939 and doing additional work toward the M.S. in E.E. His professional experience includes positions with the U.S. Forest Service. Switzer Construction Company, the Wisconsin Steel Works, and W. C. McBride, Inc. He was also instructor and coach for two years at Rhone School, Fruita, Colorado, and for a year was assistant in the Fatigue of Metals Laboratory at the University of Illinois. He is now employed in the engine laboratory of the Caterpillar Tractor Company.

Mr. McLellan received his M.E. degree from Cornell in 1939. He was captain of the fencing team and also participated in cross country and soccer. He had experience with the Pickans-Mather Mining Corporation and Filtration Engineers, Inc., before joining the Procter and Gamble Company, where he has completed a training course for production foreman and is a specialist on engine maintenance.

Engineering Show

This May 2, the Engineering College entertained over four hundred sub-frosh with their eleventh annual Cornell Day Engineering Show. Robert Ross '41 and Richard Graham '42 of the ME School; George Gentes '41 and Floyd Hathaway '42 of the ChemE School; Ed Friedrich '41, Bill Flickinger '41, and Bill Sloughter '42 of the EE School; and Warner Lansing '41 with Bob MacCallum '42 of the CE School have been in charge of the exhibits for their respective schools. C. D. Mackey, O. J. Swenson, E. W. Jones, and H. T. Jenkins were the faculty advisors.

The large crowds and numerous displays resembled the "Hall of Science" at the New York World's Fair. Apparently the engineer



Olin Hall as it will look when completed.

lives in a world just as mystifying as ever. The constant rumble and excitement throughout most exhibits helped impress the sub-frosh with the tremendous task the engineer has and is doing today. The storm of questions and the amount of participation in the exhibits by the sub-frosh indicated clearly the interest taken in this affair.

The students appeared to have as much fun as the sub-frosh for a very jovial atmosphere prevailed throughout. It is no wonder that Cornell Day has come to mean so much in the past few years, as every year new students try to outdo their predecessors in setting up and operating bigger and better displays.

Fuertes Prize

The preliminary competition for places in the annual Fuertes Memorial Contest in Public Speaking, open to juniors and seniors in the Colleges of Engineering and Architecture at Cornell University, was held Thursday, April 17, at 4 p. m., in Room 1 West Sibley, presided over by Professor S. S. Garrett, chairman of the faculty committee. Each contestant submitted a letter of not more than 400 words outlining the purpose and content of his proposed address, and was called upon to speak on the subject without notes for less than six minutes.

Those selected from this first group completed in a public contest on the evening of April 25.

Robert K. Finn, ChemE '42; William W. Sorn, AE '41; and Charles W. Lake, Jr., AE '41 won first, second, and third prize respectively. The prize was established in memory of E. A. Fuertes, former Director of the School of Civil Engineering.

The rules provide that speeches shall be original and concerned with a technical or semi-technical subject that furnishes an opportunity for persuasive argument, such as a professional question that would naturally come before semi-technical or non-technical commissions, boards of directors, or conventions.

Heating Research

Increased emphasis on the study by the College of the heating characteristics of various types of convectors and radiators has been decided upon after a meeting on the campus early this week of the Technical Committee of the Institute of Boiler and Radiator Manufacturers. Meeting at the same time was the Institute's Radiator and Convector Subcommittee.

The subcommittee met to discuss revisions of the present American Society of Heating and Ventilating Engineers' testing code on radiators and convectors. Preliminary studies made in the new constant temperature laboratory at Cornell have indicated the need for changes in the code and test procedures. Professors A. C. Davis and W. M. Sawdon and Dr. David Dropkin of the Department of Experimental Engineering will continue their research with the purpose of contributing additional information of value in the formulation of a code which will measure more accurately the efficiency of heating in various types of equipment in commercial use. Results of the Cornell research will be used by the committee, supplementing results obtained from studies in several other laboratories, most of which have been set up by the manufacturers themselves.

Flying Costs

An extensive article in the April number of *Aviation*, by Professors C. W. Terry of the College of Engineering and Paul Kellogg of the Department of Ornithology at Cornell University, entitled "The Cost of Owning and Operating Small Aircraft," should prove of special

(*Continued on page* 28)

OUR RETIRNG

This concludes our series two w seniors who have been respon for m *gineer* a success during the pas ar.

"Brain Trust"

Edmund B. King, CE

To the Senior Publication Board of THE CORNELL ENGINEER goes much credit for having produced an excellent magazine for the year 1941, and a great share of this credit must go to the retiring Managing Editor, Ed King. He has displayed his versatility in the publication of the magazine throughout his four-year connection with it, as well as in his other activities.

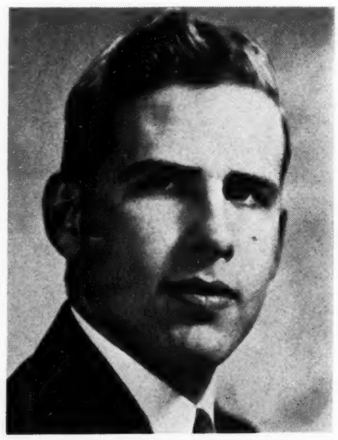
He has maintained throughout his four years in the Civil Engineering School an enviable scholastic record, and at the same time carried an abundance of scholarships. Upon graduation from East High School, Rochester, he was awarded the New York State Cornell Tuition Scholarship, and at the same time, the New York State Cash Scholarship. Later he applied for and received the McMullen Undergraduate, the University Undergraduate, and later the McMullen Regional Scholarships. At no time in the University has he carried fewer than three, and all with a cumulative general average of approximately 85%. These are indeed milestones of which to be proud.

Ed is no less versatile in other activities, having served on Willard Straight Committees in his last two years here. He was Co-chairman of the large Music Committee this year, and recently was elected to the Board of Managers of Willard Straight. In his junior year, he was chairman of the Game Room Committee, and in his senior year he is serving as a member of the Senior Ball Committee. King has been a member of the Chess Club and the Chess Team of the University, a member of the Presbysterian Choir, and was chairman of the Active Hobbies Committee, a division of the Hobbies Show sponsored by Willard Straight Hall.

In professional accomplishment Ed has shared well, also. During his four years he has been a member of the American Society of Civil Engineers, and in his junior year was elected to membership in the honorary civil engineering fraternity, Chi Epsilon. Perhaps the biggest return for work well done was election to the honorary engineering fraternity, Tau Beta Pi, recognized as the ultimate goal of all engineers for excellence. In the musical field, Ed has been a member of the Glee Club for three years, and has made many trips with them.

During his summers Ed's work has been alike interesting and full of experience. The summer after Frosh year he spent in insurance investigation and stenographic work with the firm of O'Hanlon Reports, Inc., and the summer after his sophomore year with the county engineer's department of Meadville, Pennsylvania doing surveying and drafting work. In his junior summer he passed six weeks with the ROTC in Field Artillery Camp at Madison Barracks, and later several weeks at the summer surveying camp required of civil engineering students. Ed thinks that the Army is going to call him again this summer, and has made plans accordingly, having applied for transfer to the Quartermaster Corps with the hopes of being stationed with the construction division building cantonments for the Army.

It is singular that we have the pleasure of Ed's biographical sketch appearing in this issue, in that we are at the same time giving him credit for having done an excellent job in his four years at Cornell, and thanking him for his attention and work on the ENGINEER.



"Railroad Magnate"

Colin C. Eldridge, ME

Most men, if ever lost in a forest, would need a compass to guide themselves out but the chances are that if "C-square" were ever confronted with a similar situation, he would simply "smell out" the nearest railroad and head for it. Although this is obviously somewhat an exaggeration, it is a fact that for just about as long as he can remember, railroads and railroading have had a great attraction for C^2.

C^2 is 21 years old, having been born in Yonkers, New York, in

IR[N]G SENIORS

[...] series [...] two write-ups introducing the [...] respon[...] for making *The Cornell En-* [...] the pas[...]ar.

1919. He now lives in Grosse Pointe, Michigan, a suburb of Detroit. Coming to Cornell in the fall of 1937, he brought with him his interest in railroading and became one of the founders of the *Cornell and Cayuga Railroad,* a model layout in the basement of Dean Hollister's home. He is at present General Manager of the railroad, which has grown in its four years of existence until it is now worth upwards of $1,000. Although his main hobby interest is model railroading, he shows his versatility by his interests in photography, music, Boy Scout activities. sailing, traveling, and winter sports.

During his four years at Cornell C^2 has managed to gather quite a collection of shingles, now adorning the walls of his room at the ATO house. During his freshman year he set out to fulfill one of his ambitions: to learn to row. He did learn to row but discovered that he was "too short and solid" and so decided to give the rowing up and do something else. He proceeded in the next three years to set an enviable record, being a member of A.S.M.E., a member of the '39 Freshmen Advisory Committee, General Manager of the *Cornell and Cayuga Railroad,* a member of Alpha Phi Omega, national service fraternity, and Associate Editor of this magazine. C^2 also took the advanced R.O.T.C. course in the Signal Corps, being appointed Cadet Captain in March of this year and earning membership in Pershing Rifles, Pi Tau Pi Sigma, and the Officers' Club. These extra activities however, have not interferred with his class work as C^2 has managed to maintain a high enough scholastic average to hold John McMullen Regional and Undergraduate Scholarships and the Detroit Alumni Scholarship.

Nor did he stop his activities during the summer months. Instead, C^2 spent the last three summer vacations working for the Udylite Corporation of Detroit where he was employed successively in the shipping, drafting, and research departments. Besides this work, he spent his nights during the summer of his sophomore year as a Latin tutor.

When queried as to what he would do after graduation, C^2 confided that he was quite sure of a job in the Signal Corps of the U. S. Army. After that he plans to go into industry, preferably into the railroad world.

Leonard W. Lewis, AE

A member of the Senior Board of the CORNELL ENGINEER, and, in his capacity as Treasurer, influential in making this year's magazine a

"Financier"

financial success, Len Lewis will complete a successful college career at Cornell this June as a student in the Engineering College.

Born in New York City, he was graduated from the Townsend Harris High School and entered Cornell in 1937. Completing his freshman year with marked success, he remained in Ithaca for the summer session studying Business Industrial Management. The following summer Len left studies completely behind him, visiting Lake Placid where he found time to engage in his favorite recreations, swimming, boating, tennis, and golf. Incidently he shoots close to eighty on the links. Of his many hobbies, stamp collecting and building scale models of airplanes are favorites. However, lately his studies and other interests have interfered with his pursuits along these lines.

After finishing his two year basic field artillery course, he went on to become a first lieutenant in the Reserve Officers Training Corps. The summer following his Junior year he spent six weeks at Madison Barracks, the field artillery camp. Unable to find suitable work for the rest of the summer, he became a volunteer worker for the Willkie presidential campaign.

Len has taken an active part in many activities on the campus. He has held numerous offices in his fraternity, Phi Epsilon Pi, including corresponding secretary, steward, rushing chairman, special chairman, and vice president. He was also a member of the fencing team and The Cornell Officer's Club.

As for the future holds in store for him, Len is not quite certain. Interested in aeronautics, he took that course as an elective this year, and would like to work for the United Aircraft Corporation. However the Army will probably have something to say about his future for at least a year or so.

Having a realistic viewpoint on the pending military situation, Lenny is making quite definite plans for his Army service. He has the qualifications necessary for the Air Corps Procurement Service and is doing what he can to get into this branch of service.

CORNELL SOCIETY *of* ENGINEERS

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PAUL O. REYNEAU '13, Secretary-Treasurer and Placement Director
Cornell Club, 107 E. 48th St., New York, N. Y.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

Fellow Engineers in the Senior Class:

This letter is addressed largely to those seniors in Cornell engineering who will end their undergraduate days on the hill in another short month.

It is my hope, therefore, that you do not skip over this page because it looks like "alumni stuff". Actually you are about to become one of those, and in doing so you will take on a gradually changing point of view.

First and most important, of course, is the question of a job. By this time I imagine most of you have made some kind of a decision, or are purposely avoiding the making of one. In any event, there have probably been a lot of people who have told you what you should do or should not do and have given you all kinds of advice of varying degree of helpfulness.

When you get out on your own, your new enterprise should take most of your time and energy. After a short time, however, you will find that there are other matters, in addition to the day's job, that interest you and will prove assistance in helping you progress in your career.

Among these interests none will be more important than the development of acquaintanceships among experienced men who have already taken an important place in engineering and in business affairs.

Also you will find that it becomes more difficult to keep in touch with activities at Ithaca, engineering and otherwise. At first this seems impossible, but slowly your new interests take up some of the time which you might spend in keeping in touch with Cornell.

Now I come to my point. The Cornell Society of Engineers was founded "to promote the welfare of the College of Engineering at Cornell University, its graduates and former students, and to establish a closer relationship between the college and the alumni."

This Society can be of definite help to you. First, it can be a means for you to meet and know other engineers and businessmen. Many of them are in important positions in their professions and in business, and a few are sufficiently important for the press to record their activities from time to time, but the great majority of the members of the Society are hardworking engineers and businessmen holding down above-the-average jobs, who like to recollect that they got their basic training at Cornell. Meeting with the men provides not only an evening of entertainment but often can lead to the building of acquaintanceships and friendships which can mean much to the young engineer in his future life.

Secondly, the Cornell Society of Engineers can bring to you, through its organ THE CORNELL ENGINEER, a current picture of the life at Ithaca which you will undoubtedly want to look back upon.

And more important to us all: the Society can provide a means for you to be of assistance to Cornell. It offers a channel which otherwise may not be available for the individual alumnus for expressing his appreciation and interest to the College of Engineering and perhaps to convert this interest into tangible assistance.

We are all proud of the eminent position of the Engineering College at Cornell as an educational institution and an influence on a leading profession. Cornell Engineering can only hold its position of leadership through the cooperation and help that its alumni can give to the faculty and administration. In this work you must now help.

This may sound to you a rather glowing description of the value of membership in the Cornell Society of Engineers. Actually, I think it becomes such only because when the facts are set down on paper they become more apparent.

Those of us who have our memories of undergraduate days at Ithaca particularly urge you to consider these points and to maintain your association with things engineering at Cornell by joining the Cornell Society of Engineers immediately.

Yours very truly,
John P. Syme '26
President

P.S. — To the present seniors membership cost is $1.00, including a subscription to THE CORNELL ENGINEER for the coming year. Mail your membership dues to the Secretary-Treasurer, Paul O. Reyneau, in care of the Cornell Club of New York, 107 East 48th Street, New York City.

CONCERNING *the* ALUMNI

Engineers In Defense

Among the great projects of the National Defense Program is the Ravenna Ordnance Ammunition Loading Plant in Portage County, Ohio, which when finished will represent an investment of $35,000,000 and nine hundred buildings on a tract of land five miles wide and twelve miles long.

Late last September the surveyors and contractors moved into the twenty-three thousand acre reservation to begin design and construction work for the plant. The program, an ambitious one for ordinary times, was of staggering proportions. Eighty-six miles of railroads were to be built; shell loading lines and ammunition storage buildings were to be designed and constructed, which involved miles of roads, power and telephone lines, water systems, sewage disposal plants, power houses, process equipment, and administration quarters. This was to be accomplished in from ten to twelve months' time, with only a preliminary layout of the buildings at first available—a layout on which buildings and railroads could not be located until topographical survey notes had first been mapped to guide the designers in plotting grades, curvatures, and staking buildings. This survey of thirty square miles would normally be a year's job in itself. Actual construction of railroads was started in October, however, and by the middle of December the entire area was teeming with activity.

To put this tremendous operation into gear and accelerate its speed to completion by the late summer of 1941 created many difficulties, all of which had to be solved quickly and with little time for intensive study. The needed railroad mileage was acquired by purchasing a stretch of railroad in Maryland and shipping the rails to Ohio, ties and hardware being obtained wherever stock was available. Since the typical secondary country roads within the reservation would not withstand more than a week of heavy trucking, twenty-six miles of these were resurfaced with bitumastic macadam. The two hundred fifty bridges, rated at five-tons capacity, were rebuilt for seventy tons, both the road and bridge jobs being completed by November. Little railroad construction having been done in that part of the country for the past twenty-five years, it was necessary to teach labor to handle ties and rails and to swing the spiking sledges before the track gangs could move out to work.

When the November bad weather set in, it became evident that railroads were the only satisfactory means of travel to the flat and swampy construction areas; but completion of the mileage necessary to serve all of the buildings was a physical impossibility in the sixty days allotted. Hence a unique plan of operation was instituted which overcame this difficulty at once. A central concrete plant was erected, and wells were drilled adjacent to this plant to supply water. From this central plant standard gauge tracks were laid with proper grading to the edge of each construction area. Then into transit concrete mixers, mounted three to a standard gauge flat car, were charged cement, sand, stone, and water; at the edges of the construction areas the concrete was poured into one-yard dump buckets. From the Pennsylvania Turnpike was brought narrow gauge Diesel locomotive and flat car equipment, this being used to haul the buckets of concrete to the building sites over tracks laid directly on the ground with no attempt at grading. By this means the necessity for many separate wells and concrete plants was eliminated and all construction was well under way in a short time.

Subsoil conditions throughout the area varied from hard rock to quicksand. Shell Loading Line No. 1, due to begin operation in early summer, required very heavy rock excavation, twenty feet deep in places. Other building groups had quicksand under the foundations, which required extensive pile driving. Three weeks of November rains ruined miles of originally foundationless roads and put truck traffic practically at a standstill. From the rock cuts in the loading lines, thousand of yards of rock were hauled, and the roads were rebuilt with this material to depths of four and five feet to bring them out of the swamps. By December all the roads within the thirty square miles were in excellent condition.

To accommodate six thousand men in this farm community was a major task in itself. To effect the buildings of housing and feeding facilities within thirty days, the contractor wired for plans of the construction camp in operation at Shasta Dam in California. The plans were sent by air-mail, and within forty-eight hours after receipt of the contract, work was started on a duplication of the Shasta camp, with no time lost in

Robert E. Swinney, CE '08, passed away on February 18th at his home in Baton Rouge, Louisiana. He is survived by his wife, a son, and a daughter. The son is a graduate of the University of Louisiana and was associated with his father in the general contracting business.

preparing designs. A hurried trip to the New York World's Fair, which had just closed, brought forth kitchen equipment, tables, chairs, etc., which could not be obtained anywhere else in less than four months.

Many Cornell engineers are associated with the various departments building the Ravenna Ordnance Plant. Lloyd E. Bemis C.E. '19 is chief auditor for the War Department. For the Atlas Powder Company, Daniel D. Huyett M.E. '12 is designing engineer. Samuel E. Hunkin C.E. '16 is vice-president in charge for the Hunkin-Conkey Construction Company, general contractors; among those on his staff are James D. Price C.E. '16, Henry F. Gerhauser ME '42, and William J. Hunkin AE '43. Trygve W. Hoff C.E. '21 is chief of design for Wilbur Watson and Associates, Architects and Engineers; also representing this company at Ravenna is Clarence E. Scott C.E. '30.

The Commanding Officer and Constructing Quartermaster for the project is Lt. Col. Raphael S. Chavin '16, a graduate of the College of Arts and Sciences. Other Cornellians at work in Ravenna include three graduates of the College of Architecture and six graduates of the School of Hotel Administration.

Shells will be loaded in June and bombs in August at this vast plant whose nine hundred buildings would, if laid end to end, comprise one building almost twelve miles long. The project is ahead of schedule despite numerous difficulties; considering that on October 1, 1940, there was not even a survey or an approved plan in existence, this operation will take its place with the other great engineering and construction feats being achieved in these hectic times. It is but one of the projects in our National Defense Program which proves that American engineering and construction genius is still unchallenged in the world today.

All alumni of the School of Civil Engineering and their families are invited to the eighteenth annual civil engineering breakfast on Saturday, June 14. This affair, which has become a commencement tradition, will be held in the recreation room of Sibley Dome from 8:00 to 10:30 a. m.

Newbury Elected

F. D. Newbury, a graduate of the College of Engineering at Cornell University in 1901, has been elected vice president of the Westinghouse Electric and Manufacturing Company, according to an announcement in the current issue of the company's magazine. He has spent his entire business career with the company since enrolling in the training course in 1903.

After serving in several capacities, including that of design engineer, he was appointed assistant to vice-president in 1935, in con-

(Continued on page 25)

Engineers In Aviation

(*Continued from page 7*)

an entire new factory for the purpose of building only one type of airplane. The company's procurement program will also depend to a large extent upon the number of units produced, since castings and forgings will be used on large orders of airplanes where it might be profitable to use machining processes on smaller orders of the same airplane. The planning which is done at this stage of the game determines to a large extent whether or not the company will successfully produce an order of airplanes, even though the prototype or experimental airplane was found to be very successful.

From this description of the design of an airplane from the early stages through to its production in large numbers, we have seen that all phases of engineering have played important parts in its successful completion. Proper coordination of the efforts of all of these groups is indispensable to the construction of aircraft. However, there are other fields in aviation besides the production of aircraft. These include aeronautical research, engine research and development, materials research, meteorological surveys, the design and fabrication of instruments and communication equipment, studies of the physiological effect of high altitudes and accelerations on the human body, and many other phases.

Research

The tremendous importance of aeronautical research cannot be overemphasized at the present time. This work requires such unusual and expensive equipment that it cannot be undertaken by private individuals to any large degree, and even the major aircraft manufacturers are unable to make the large expenditures required for such equipment. At the present time most of the aeronautical research which is being done in the United States is concentrated in the National Advisory Committee for Aeronautics in its laboratories at Langley Field, Virginia, and Moffett Field, California. Within the next few months another NACA laboratory will be in operation at Cleveland, Ohio. The recent expansion in the facilities of the NACA was made necessary by the increased importance of aerodynamic refinements which occurs as the speed and loading of modern aircraft increases.

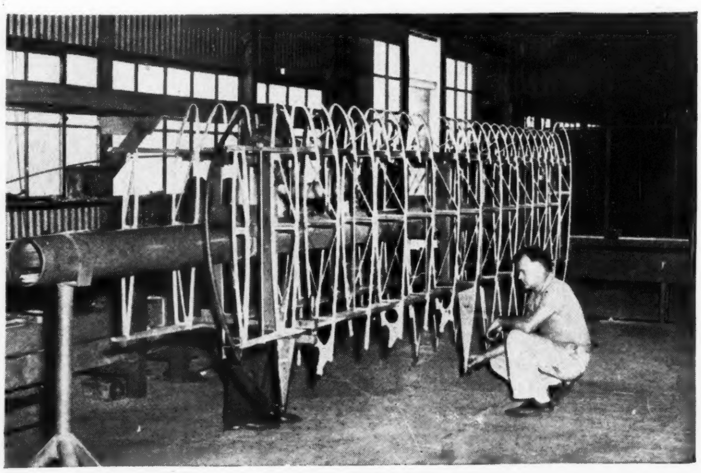
The aerodynamic problems are studied analytically by engineers whose training has been principally within the fields of mathematics and physics, as well as by men who approach aerodynamic problems with training as aeronautical engineers. Their equipment consists of various types of wind tunnels and aircraft especially suited for flight testing. Each of the wind tunnels is designed for some fairly narrow field of testing, which may be to study low turbulence air flow over airfoils or to study flow through radiators and ducts in models and full-scale installations or even to measure the lift and drag characteristics of a complete airplane. Some of the tunnels designed for model tests can be operated at pressures above atmospheric, so that the Reynolds number will be directly comparable with that of the full size airplane in normal flight. The men involved in this type of research continually encounter problems which have never been recognized as important, and are forced to design equipment and instruments for use in making the proper tests and also to supervise such testing as may be necessary.

In addition to the work on aerodynamics the NACA does considerable research on aircraft engines and accessories. The new laboratory at Cleveland is being constructed for this specific purpose and will greatly augment the present facilities at the Langley Field laboratory. This work includes studies of combustion, fuels, lubrication, methods of engine cooling and coolants, superchargers, ignition systems, structural design of the engine parts, and many other phases of engine work. In this laboratory alone the services of a large number of mechanical engineers, electrical engineers, physicists, chemists, and other technically trained men are required.

Other important branches of the work of the NACA are the hydrodynamics research and structural research which are being carried on at Langley Field. The complex motions which arise through lateral and longitudinal instability of an airplane taxing over water have given seaplane designers a very difficult problem in the past few years. These and many other problems are being studied by naval architects, aerodynamicists, and other types of engineers. One of the smaller laboratory groups is engaged in the important work of research on aircraft instruments which are used for studying the response of an airplane to various types of maneuvers, gust loads, and landing loads. Normal flight instruments are also studied by this group, as well as all types of instruments used in aerodynamic, structural, hydrodynamic, and engine research.

At the present time the major part of the metallurgical research which is being done in the United

Mechanical engineers must design these wing jigs for proper strength and stiffness.



States is being carried on by the Army, the Navy, and the National Bureau of Standards in conjunction with various manufacturers. Metallurgists and chemical engineers are engaged in this work, and through their close contacts with the aircraft industry and a thorough knowledge of its problems have produced many materials in the past few years which show considerable promise and will go far in producing more efficient and safer aircraft.

Therefore, in the field of research alone, the aeronautical industry requires the use of all kinds of engineering talent in addition to the services of professional men from almost every field.

Operation and Maintenace

The proper operation of aircraft requires complete knowledge of the weather conditions which will be encountered in flight and means for preventing interruptions in flight schedule due to various types of weather conditions. For example, proper ice removal equipment must be designed for purposes of protecting the wings, tail surfaces, propellers, and carburetors of aircraft, both military and civil. Means must be found for enabling aircraft to land through heavy overcasts and low clouds. This requires considerable study by aeronautical research men and radio engineers so that satisfactory protective equipment can be developed.

These and other problems have been under study for several years, and we are now much closer to their solution, so that ultimately the weather will have but slight effect on the dispatching of aircraft. Military aviation has brought up several physiological problems in connection with flight through rarefied atmosphere at altitudes above 30,000 feet, and these are now being studied by the Army and Navy in conjunction with the medical profession and aircraft manufacturers.

Maintenance and servicing of aircraft are very important to the efficient operation of large numbers of aircraft either as civil air carriers or military transports and fighters. It would be of little use to have several thousand military aircraft on hand when facilities for refueling and repairing limited the operator to using a few hundred planes at a time. These servicing problems are extremely important and require considerable planning on the part of the maintenance engineers.

Conclusion

It is hoped that this brief story of the engineer's place in the aviation industry of today will serve to emphasize the fact that only a comparatively small number of the men in this field have been trained as aeronautical engineers. Some of these men have studied aerodynamics, but an even larger number are mechanical, civil, electrical, and chemical engineers, with a good proportion of physicists and chemists. All of the men involved in this work are fully acquainted with the necessity for producing lighter, stronger, and faster airplanes which will carry greater loads with increased safety. All are working with this common goal in mind, and this end can be achieved only through the proper coordination of the efforts of all engineering and research groups.

Yellow River

(*Continued from page* 10)

the low sandy lands, will weaken the main current of the river and cause subsequent silting of the river bed, is another result of unnecessary overprudence.

In conclusion is it necessary to mention the role of experimental study. At present, science has reached a mature middle age, but river engineering is still in its infancy. Rivers are always of a flexible and protein nature. They flow over the surface of the earth in a manner similar to the circulatory system of the human body. Our knowledge of the river is far behind the investigations made on the arteries and veins by the anatomists and pathologists. In the comparatively short period since Mr. Engels initiated the use of model studies, European hydraulicians have made considerable progress in the investigation of flowing water. For many years it was the policy of those in charge of regulating the Mississippi River in the United States to adhere conservatively to the old scheme for river regulation. However, repeated floods occurred during the 20th century. In the years 1912, 1913, 1916, and 1922 considerable damages were suffered. During the flood of 1927 the levees broke in 11 places along the main river and countless breaks occurred along the tributaries. The area flooded was over 28,000 square miles and 700,000 calamity-stricken people were involved. This flood is comparable with the Yangtze-Kiang flood of 1931 and the Yellow River flood of 1933. The only difference was that rescue measures were more comprehensive and well planned and the suffering was less in the case of the Mississippi River Flood.

The people of the world were awakened by the discovery that conservative methods were not adequate to meet the situation. Therefore with united knowledge and strength they began to seek for more thorough and efficient methods. At a most opportune time during this transition period the United States Waterways Experi-

(*Continued on page* 25)

Gorge of the King Ho, Shensi, where samples have shown 50% silt by weight.

Foundry Cores

(*Continued from page* 13)

the oven. This type is limited in design to the handling of light cores.

The mono-rail conveyor can be designed to carry its core racks in any direction; up, down, around corners, etc. This means that the racks can move past the core-makers' benches and into the oven, where capacity and baking time can be increased without increasing the oven length, by having the racks make a number of passes through the oven. Where overhead clearance permits, it is often possible to effect great economies of floor space with this type of oven by having it supported entirely off the floor and placing core-makers' benches beneath it. In all types of conveyor ovens the recirculating heating system, oil or gas fired, and equipped with automatic control devices, is almost universally used.

For baking large heavy cores and dry sand molds which cannot be hand loaded, the car-type oven is preferred. On tracks running into an oven similar to that type used with portable racks are placed one or more cars equipped with wheel bearings which will not be affected by the interior temperature of the oven. In operation, the car is loaded and rolled into the oven, the cores baked and cooled, the car removed, and the cores transported to the molding floor or to storage.

It should be mentioned at this time that there are many who favor the use of dry sand molds, claiming for them less hazard in getting good castings, lower cost of cleaning the castings, better looking castings, and castings which are truer to the pattern and therefore easier to machine. On some classes of work, or where skilled molders may be hard to get, unskilled labor may often be used advantageously in the making of dry sand molds.

Whether in shelf, rack, drawer, or conveyor type ovens, the cores are placed on large, tray-like core plates for baking. In the past it was necessary to use massive plates which would not be affected by heat and temperature differentials within the oven, these plates constituting a large part of the load. Consequently, as much heat was often required to raise and hold the plates at the baking temperature as was needed to bake the cores. The advent of modern controlled heating systems has meant the elimination of excessive temperature variations, and very light perforated plates have largely supplanted the heavy plates once in use.

Core-room practice has advanced a great deal since those days when a core oven was merely a brick box containing a fire in one corner of the floor. Most foundrymen now realize that coremaking in all its phases is a science, and that the application of new scientific knowledge as it becomes available through research, is purely and simply good business practice.

Yellow River

(*Continued from page* 23)

ment Station was established at Vicksburg, Mississippi. The inadequate policies of the past were discarded and a thorough and fundamental investigation was begun on bed-load transportation and methods of bank protection. The investigation of storage reservoirs is also on their program of research. The study and the results will be of considerable value to us.

With our feeble financial strength augmented by support from several organizations we have located the first hydraulics experiment station at Tientsin. (It is now under construction.) It is advisable to provide a larger experiment station at Miao-Kung (on the north bank of the Yellow River near the Pei-ping-Hankow Railway Bridge) for special research on the Yellow River alone. It is suggested that the arrangement follow that used by Engels at Obernach. Maio-Kung is located in the Wu-Ling *hsien* district (Ed. Note: A "hsien city" is a "county seat"). The station is about 5 km from the railway station on the north bank of the Yellow River. The large buildings in this area can be used for offices. Water drawn from the Yellow River or the Chin-Ho may be used for outdoor experiments. A study of silt and loess problems can also be conducted at this station. If this experiment station is completed our knowledge and understanding of Yellow River regulation will, in the course of years, become more lucid, more complete, and more precise.

ALUMNI NEWS

(*Continued from page* 21)

nection with budgets and other administrative problems. He also became the company's economist, and in 1938 was made director of the New Products Division. Since July, 1940, he has been manager of the Emergency Products Division. During recent years he has come to Ithaca on numerous occasions to lecture to students in the College of Engineering.

Former Editor Engaged

Harry Johns, A.E. '39 has announced his engagement to Ruth Alessandra Le Dorf of Goshen, N. Y. Harry was Editor-in-Chief of the Cornell Engineer during his senior year, and is now living in Great Neck, N. Y.

THE FACULTY

Professor O. J. Swenson

The question has been asked often, "Why not let the chemical engineer be more an engineer and less a chemist?" and in Baker Laboratory there's a man with that same idea—Assistant Professor O. J. Swenson—who believes that a chemical engineer should be able to "engineer" his own way along and not have to ask the professional advice of other engineers on the construction of factories and plants having to do with industrial chemical processes.

"Chemical Engineer"

It is certainly a pleasure to talk to this man, whom many of us have never met, with such a varied and yet integrated background as he possesses. Born on what he describes as a "wheat ranch" in North Dakota — and it's a ranch, for it contains upwards of 3,000 acres —he was the second of five brothers. Early he discovered that he possessed a mechanical turn of hand and mind, and coupled with a knowledge of farm machinery. Thereupon he set out, as one does with an inclination, to the University of Minnesota to study mechanical engineering. But it seems that this selfsame farm machinery had taught him much more than he thought, for he found the elements of mechanical engineering already developed, and in order to learn something new and still stick to engineering, he turned to the chemical field. He was without definite plans for following the engineering industry, and he regarded his home, the wheat ranch, as an engineering problem of attaining efficiency with a maximum of economy; and it was with the ranch in mind that he studied chemical engineering. The University of Minnesota conferred the degree of Bachelor of Chemical Engineering upon him in 1931, and he immediately turned to graduate work for further research. During his graduate days, he again chose chemical engineering as his major study for a Doctor of Philosophy, and mechanical engineering as his minor. In this connection, he designed special farm machinery as class problems, and then built the machinery during the summer on the farm. As an example of some of the things he undertook, he designed and built probably the largest windrow-type harvester in use, driven from behind by a tractor so that the entire field is cut, instead of leaving corners and borders uncut. At this same time he became interested in using lignite, a variety of coal intermediate between peat and bituminous coal, as a fuel for tractor usage. Since the ranch on which he grew wheat is situated upon beds of lignite, it seemed to him extremely profitable to use the fuel for the many tractors and engines employed in the mechanization of a farm. Consequently, he petitioned for a change in his Ph.D. problem, and thereafter applied his talents toward separating the tar from the lignite, since the pistons of his experimental engines had stuck to the cylinders after six or seven hours of operation. As a successful climax to this practical research, he was awarded the degree of Doctor of Philosophy in chemical engineering by the University of Minnesota in 1935. Professor Swenson, when queried as to the practicability of gas-producer engines for war usage, answered that he thought them impractical, since war machines required easy mobility and compactness of fuel, neither of which appears in the use of lignite.

After graduation from the Minnesota Graduate School, he was employed by du Pont in the Industrial Engineering Division, at various plants throughout the country, notably at Wilmington, Delaware, and in the Dye Works and Cellulose Acetate Plant. In 1938 he came to Cornell in the Chemical Engineering School, Assistant Professor.

There is quite an interesting connection between Professor Swenson and the new Olin Hall of Chemical Engineering. He is at present in charge of "course 710", or the Unit Operations Laboratory, and his plans for the new 710 lab in Olin Hall include quite a few complete chemical plants on a semi-scale layout. This is where his ideas about chemical engineers enter in. In the design of a chemical plant, the chemical engineer often has to consult other mechanical and civil engineers for the construction details, and in this manner the mechanicals and civils often lack understanding of the requirements of the plant, and much time is lost and misconstruction often results. It is Professor Swenson's contention that the chemical engineer should have a sufficient grasp of chemistry and all engineering principles to enable him to bridge the gap between the chemist and the practical, producing engineer, without calling for help from engineers trained in another field. And now Professor Swenson is having the enjoyment of applying his experience and training as a mechanical and chemical engineer to the job of designing the new semi-scale plants that will go into Olin Hall.

The hour we spent in Professor Swenson's office and lab, in which we learned of industrial fractionating and other vital chemical processes, was a most interesting one; we learned that here is a man well worth the cultivation of friendship, and in whom there rests more than the personality of a professor. We'd like to introduce you now with this short biographical and informal sketch to the man we want you to know.

COLLEGE NEWS

(Continued from page 15)

interest to engineers taking the C.P.T. course.

"The recent stimulus given to aviation by the government subsidy, in the form of Civilian Pilot Training courses, has caused many individuals to consider the cost of flying," they explain. "Pilots trained under the new program are faced with the problem of continuing their flying, and they must continue it if they are to keep their coveted ratings." The authors go on to present an exhaustive analysis of the cost of operating small planes on an annual basis.

As an example, they consider a used plane, perhaps a year and a half old, purchased for approximately $1,500. Overhead will average $723 a year, and the hourly operating cost will be $1.32. They point out, therefore, that if the plane is operated only 100 hours during the year, the cost per hour of operation will be $8.55, and it would be less expensive to rent a plane. If however, the plane can be flown 1,000 hours a year, the cost per hour decreases to $2.05. The conclusion reached is that for most persons the best solution is joint ownership, perhaps through a flying club, so that the plane may operate as nearly as possible to the 2,000 hour yearly maximum permitted by average weather conditions.

Ward Speaks

"Much of the confusion in the public mind concerning the American aircraft production program comes from lack of knowledge of the time needed to design, construct, and test a combat airplane," J. Carlton Ward, Jr. M.E. '14, president of the Fairchild Engine and Aircraft Company, told engineering students on March 8. "The normal time for putting a new aircraft engine into production is five years, and the time for completing the entire plane is necessarily somewhat longer."

To illustrate his point, Mr. Ward told the story of the Douglas B-19 bomber, an 82-ton craft which can stay in the air for 48 hours and could fly from Los Angeles to Berlin and back to New York non-stop, with a full load of 18 tons of bombs. "The U. S. Army," he declared, "had the foresight, despite lack of public sympathy with its efforts, to begin plans for this bomber in 1933. One year later a competition for designs was concluded and the problem of developing the craft assigned to the Douglas Company. The first model will come out of the factory in April of this year, will be put through ground tests until June, and then must undergo intensive flight tests, including participation in Army maneuvers under actual combat conditions. The planes will be ready for use sometime in 1942."

This schedule of development cannot be hurried, he emphasized, and it takes a longer time than that necessary for the design and construction of a battleship. "The moral is," he concluded, "that the most economical and effective way to take care of national defense is to do much of our preparation in times of peace. If the needed development of military aircraft could have been started five or six years ago, we should have saved an immense amount of time and money. Trying to buy time, as we are doing now, is an extremely wasteful process. This is a lesson that should be pondered when the present emergency is past."

Mr. Ward, a graduate of the College of Engineering in 1914 and a member of the Engineering College Council, was formerly vice-president and general manager of the Pratt and Whitney Division of United Aircraft, and is recognized as one of the country's leading authorities on aviation.

Bigelow Talks

"Most strikes would not occur if management, employees, and the public had complete information about the finances of the industry involved," J. H. Bigelow, personnel adviser of the New York Telephone Company, told senior engineers on April 11. "Business must be conducted for the good of all concerned, and if this principle is followed and all those involved know it, labor would have no just grievance and would not resort to strikes."

Mr. Bigelow linked business ethics with the world-wide clash of philosophies basic to the World War. "The issue is now sharply drawn," he declared. "Everyone admits that human nature must be controlled. It must either be controlled from the top, by dictatorship, or controlled from within, by the people themselves. American business in the past has sometimes been guilty of the practices of dictatorship. Now it is rapidly introducing the practice of democracy, recognizing that the profit motive is not enough, that the fundamental rights of people, who in these days live in close proximity to one another, must be observed. Profits must, in these times, be equitably distributed among workers, owners, and the public.

"Money no longer gives as much power as it used to give to a favored few. Income taxes and social security legislation are steps in the right direction, but they were Government actions, made necessary because business had not done a satisfactory job of controlling itself. It is evident that the Government can't make rules for everything. People who run businesses must in greater measure set up ethical rules for themsleves."

EE's Learn Geometry

Dr. Eric T. B. Gross, formerly a resident doctor and Westinghouse research associate in the School of Electrical Engineering and now instructor in electrical engineering at the City College of New York, addressed the Student Branch of the AIEE Wednesday evening, April 16, in the Franklin Hall lecture room. His topic was, "Euclid Applied to Circle Diagrams."

"Most of the problems in electric circuit analysis, especially those in electrical machinery and power transmission, lead to circle diagrams." Dr. Gross showed that these circle diagrams can easily be found by the application of the principles of elementary geometry.

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STRESS *and* STRAIN

Professor Plusorminus One was amiably picking dandylines of force in a magnetic field in the Physics building. He was silently humming to himself "Who's Asquared of the Big Bad Root," as he gently nursed atomic ache. His assistant, Young Modulus, stepped down into the room as if in a transformer. "Why insulate?" queried the professor.

"Am insulate? Don't torque." answered Modulus, "I was out last nite to a density and got into a hell of mass."

"It's the thermal story again," answered the professor, becoming heated. "When a little P-V like you starts running around in cycles!"

"Magnerts," Young Modulus cried. "My sweetheart is coming to the city and I was centimeter. She hasn't derived yet. When she comes I'll be King Faraday."

"Are you marrying for harmonic?" asked the professor. "And, by the way, when is the wedding?"

"I'll oscillator," came back his answer.

"Vibrate?" the professor demanded. "Do it now!"

"I spectra any minute." Suddenly the door opened and dynamic Equilibria breezed into the room.

"I'm solenoid at you," she cried to her sweetheart. "You've driven me to diffraction!"

"Who is dispersion?" Professor Plusorminus One asked.

"I'll trouble you to be more polite inductance to my sweetheart!" Modulus cried.

"Is this effect?" the professor retorted. "I happen to know about it through Voltage Vinchell. I hear you're expecting a blessed momentum!"

"Yes, I went shopping for baby clothes yesterday," she replied.

"I kinetics physics percent less at Macy's," Modulus told her. "But sweetheart, I haven't seen you for so long. Take me by force of gravity!"

"I can never B.T.U. more than a sister," she said.

"However that may be," concluded Modulus, "you're still my mechanical equivalent of heat."

—Nebraska Blue Print

Wig: "Why are all Cornell freshmen like Sanka coffee?"

Wag: "Dunno, why?"

Wig: "Each one is either a drip, grind, or 98% of the bean is inactive."

* * *

First Diner: "That waiter is either a fool or a humorist."

Second Diner: "What's the matter?"

First Diner: "I ordered extract of beef, and he brought me a glass of milk."

* * *

If your roommate keeps on talking in his sleep, we're going to send him home to mutter.

* * *

Then there is the fellow who went spooning the other night with his sugar and found there was nothing stirring.

* * *

Nurse: "I think he's regaining consciousness, Doctor; he just tried to blow the foam off his medicine."

—Oklahoma State Engineer

* * *

He: "Here's how."

She: "Say when. I know how."

—Oklahoma State Engineer

* * *

The teacher was quizzing the class, "Now who can tell me who gave us our nice schoolhouse?"

"Franklin Delano Roosevelt, teacher."

"That's right, Johnny. Who knows who gave us our beautiful parkways and parks?"

"Franklin Delano Roosevelt, teacher."

"Now, who gave us this broad concrete road through the park?"

"Franklin Delano Roosevelt, teacher."

"That's right, Mary. Who gave us the birds and bees, the flowers and trees?"

"God did, teacher."

Voice from the back of the room, "Throw that d——— Republican out of here."

* * *

New Dealers see WPA in action. Conservatives see W P A inaction.

She: "I want to see the Captain of this ship."

Seaman: "He's forward, Miss."

She: "That's all right, I'll take care of him. I went with a Cornell Senior once."

* * *

Sweeny: "Every time I kiss you it makes me a better man."

She: "Well, you don't have to try to get to heaven in one night."

* * *

Ensign Prof.: "This examination will be conducted on the honor system. Please take places three seats apart in alternate rows."

* * *

Waiter: "Would you care to drink Canada Dry?"

Cornell Eng.: "Yeah, but I'm only going to be here for the week-end."

* * *

She: We've been waiting here a long time for that mother of mine.

He: Hours, I should say.

She: Oh, George, this is so sudden.

* * *

As I try to study at night,
I can only think of that terrible fight,
And if we must, why not join right in,
Before our own damn tests begin.

—Stretch

* * *

Math Professor: "Now watch the blackboard while I run through it once."

* * *

You would not pan
The jokes we use
If you could see
Those we refuse.

* * *

Friend: Did you get any replies to your advertisement that a lonely maiden wants light and warmth in her life?

Spinster: Yes, two from electric light companies and one from a gas company.

* * *

Kodiak, the Eskimo, was sitting on a cake of ice telling a story. He finished and got up. "My tale is told," he said.

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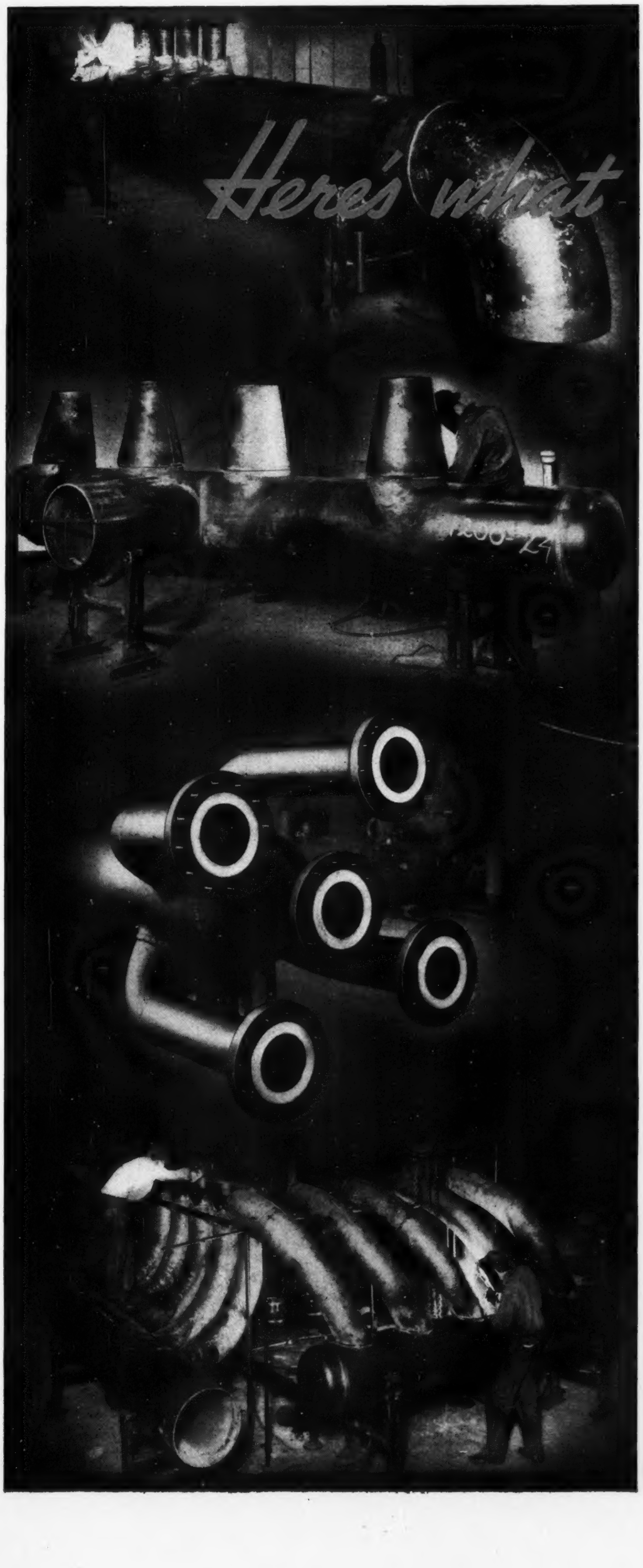
Here's what

G-E Campus News

JUNGLE JIVE

MISSIONARIES working among a newly discovered tribe of savages in Netherlands New Guinea, which has many times been called one of the "earth's remotest spots," had a strange experience.

They invited natives into their bamboo hut and turned on their short-wave radio. The tribesmen looked at one another in frightened amazement. Rev. C. Russell Deibler, one of the missionaries, says this of what happened: "As they heard voices coming from the receiver, they crouched over close and jabbered back, utterly bewildered where the strange voice was coming from."

The missionaries wrote their experience in a letter to Station KGEI, G.E.'s short-wave station in San Francisco, which sends its radio signal into Asia, using special directional antennas.

PRESTO!

THREE tiny 1000-watt mercury lamps, mounted in the new television floodlight developed by G-E laboratory engineers, yield as much light as 225 ordinary 60-watt bulbs. For the same amount of illumination these powerful little lights produce only one-fourth as much heat as do incandescent lamps. Water cooling dissipates much of the heat and so makes possible the very small size.

The new lights are equipped with motors and gears for remote control, so that they can follow the movements of studio performers.

These tiny lamps were developed at G.E.'s Lamp Department at Nela Park, Cleveland, which each year selects promising young engineering-college graduates from "Test" to train them in the lighting game.

SPIDERCRAFT

COULD you spot-weld wire one quarter as thick as a human hair?

That's the problem G-E engineers faced in producing filaments for thermocouples, those little super-sensitive devices used in measuring high-frequency alternating currents or voltages. These dainty filaments are 1/2000 of an inch in diameter—so small that they are almost invisible—and have to be welded into a "K" shape.

The work is so fine that it must be done under a microscope, using a pair of tweezers to hold the wires.

At Schenectady there's a whole section of the G-E Industrial Department devoted entirely to welding. Practically all the men in this section are graduates of the G-E Test Course. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

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